REMARKS

Claim Amendments

Claim 27 has been amended to positively recite a limitation found in its preamble.

Specification Amendments

The specification has been amended to include language found in the figure legend of Fig. 2 as originally filed.

New Claims

New claims 39 and 40 have been added to the application.

Claim Rejections

The claim rejections will be addressed in the order set forth by the Examiner in the Official Action.

35 U.S.C. 102(b)

Claims 1-9 and 25-26 (Hayakawa et al.)

In item 2 of the Official Action, the Examiner rejects claims 1-9 and 25-26 under 35 U.S.C. 102(b) as being anticipated by U.S. patent 4,824,518 to Hayakawa et al. The Applicant respectfully disagrees for the reasons discussed below.

Claim 1 recites, "*depositing a first layer of a first material over the surface of the first crystal; depositing a second layer of a second material over the first layer; and epitaxially growing the second crystal over the second layer*".

In Hayakawa et al., a GaAs substrate is provided and exposed to radiation treatment of As_4 to help provide a surface free of oxide. Subsequently, a layer of $(Al_xGa_{1-x})_yIn_{1-y}P$ is deposited using molecular beams, thereby resulting in high-quality GaAlInP epitaxial growth layers on the GaAs substrate (See Col. 5, lines 18-19). However, prior to the deposition of the GaAlInP layer, the As_4 is removed (See Col. 4, lines 60-62). As such, Hayakawa teaches one layer deposited on the substrate.

Hayakawa teaches other variations in which a GaAs buffer layer is grown on the substrate followed by the epitaxial layer. However, even when a buffer layer is grown, only two layers are deposited on the substrate. As such, Hayakawa et al. does not teach "*depositing a first layer of a first material over the surface of the first crystal; depositing a second layer of a second material over the first layer; and epitaxially growing the second crystal over the second layer*" as claimed in claim 1 of the present application.

It is therefore submitted that claim 1 is patentable over Hayakawa et al. Since claims 2-26 are directly or indirectly dependent on claim 1, it is submitted that claims 2-26 are patentable for at least the same reason. If the Examiner disagrees, he is respectfully requested to specifically point out the parts relied upon in Hayakawa which disclose the features of claim 1 in accordance with 37 CFR 1.104(c)(2).

<u>Claims 27-29 (Hayakawa et al.)</u>

In item 2 of the Official Action, the Examiner rejects claims 27-29 under 35 U.S.C. 102(b) as being anticipated by U.S. patent 4,824,518 to Hayakawa et al. The Applicant respectfully disagrees for the reasons discussed below.

Claim 27 recites the language "*depositing a first layer of a first material over the surface of the substrate; and depositing a second layer of a second material over the first layer, wherein the crystal is deposited over the second layer*." As discussed under the heading <u>Claim 1 (Hayakawa et al.)</u>, Hayakawa at best teaches a buffer layer and epitaxial layer grown on a substrate. Hayakawa does not teach "*depositing a first layer of a first material over the surface of the substrate; and depositing a second layer of a second material over the first layer, wherein the crystal is deposited over the second layer*" as claimed in claim 27.

It is therefore submitted that claim 27 is patentable over Hayakawa et al. Since claims 28-29 are directly or indirectly dependent on claim 27, claims 28-29 are patentable for at least the same reason. If the Examiner maintains his rejection of claim 27, he is respectfully requested to specifically point out the parts relied upon in Hayakawa in accordance with 37 CFR 1.104(c)(2).

<u>Claim 1 (Ogasawara)</u>

In item 4 of the Official Action, the Examiner rejects claim 1 under 35 U.S.C. 102(b) as being anticipated by U.S. patent 4,897,367 to Ogasawara. The Applicant respectfully disagrees for the reasons discussed below.

Claim 1 recites the language "*wherein said first layer substantially accommodates strain accumulated between the first crystal and the second crystal...*". At page 5 of the Official Action,

the Examiner states that Ogasawara discloses a first crystal of Si, a first layer of As, a second layer of Ga, and a second crystal of GaAs. It is the Applicant's belief that the Examiner intended to mean a first layer of GaAs and a second layer of GaAs, as shown in Fig. 3 of Ogasawara. In addition, the Examiner states that "it is inherent to Ogasawara to have a first layer which accommodates strain accumulated by the second crystal because he [Ogasawara] teaches a similar first layer and a similar second crystal grown epitaxially thereon."

As shown in Fig. 1 of Ogasawara, there is a Si substrate 1 on which a GaAs layer 2 is deposited, followed by the subsequent deposition of a Si layer 3, GaAs layer 4, and GaAs layer 5. As discussed at Col. 3, lines 22-25, the combination of the GaAs layer 2, Si layer 3, and GaAs layer 4 acts to prevent warping caused by different thermal expansion coefficients of the Si in the Si substrate 1 and the GaAs of the GaAs layer 5. The Examiner will appreciate that claim 1 recites "*wherein said first layer substantially accommodates strain accumulated between the first crystal layer and the second crystal layer.*" At best, the first layer recited in claim 1 can be compared with the GaAs layer 2 in Ogasawara. The GaAs layer 2 in Ogasawara does not accommodate any type of strain because Ogasawara teaches that the <u>combination</u> of the GaAs layer 2, Si layer 3, and GaAs layer 4, are used to absorb warping caused by different thermal expansion coefficients. As such, Ogasawara does not teach that "*said first layer substantially accommodates strain accumulated between the first crystal layer and the second crystal layer*" as claimed in claim 1.

<u>35 U.S.C. 103(a)</u>

<u>Claims 3-24 and 30-31</u>

In items 6-10 of the Official Action, the Examiner rejects claims 3-24 and 30-31 under 35 U.S.C. 103(a) as being unpatentable. At least for the reasons discussed above under the heading <u>35</u>

U.S.C. 102(b), claims 3-24 and 30-31 are patentable.

Claim 32

In item 10 of the Official Action, the Examiner rejects claims 32-33 under 35 U.S.C. 103(a) as being unpatentable over Hayakawa et al., in view of U.S. patent 4,876,218 to Pessa et al., along with Ogasawara, and further in view of U.S. patent 5,094,974 to Grunthaner et al. The Applicant respectfully disagrees for the reasons discussed below.

Claim 32 recites the language "*depositing a condensed layer of As_2 on the surface of the substrate...including the steps of: subjecting the substrate to an As_2 vapor pressure of about 0.008 pa, whereby a condensed layer of As_2 is formed on the surface of the substrate ..*"

In claim 32, a condensed layer of As_2 is deposited on the surface of the substrate at a vapor pressure of about 0.008 pa. By forming a condensed layer of As_2, the As atoms have the ability to move slightly which helps alleviate strain between the substrate and a layer deposited over the condensed As_2 layer.

At pages 12- 13 of the Official Action the Examiner indicates that Hayakawa et al., Pessa et al., Ogasawara, and Grunthaner et al. teach "a radiation treatment by an As_4 molecular beam, where As_4 is an equivalent source of Arsenic to As_2, with about 10^{-5} torr, 0.0013 Pa,.....where a pressure of 0.013 reads on Applicant's 0.008 Pa, but if this is not the case than [sic] it would have been obvious to a person of ordinary skill in the art...because pressure is a result effective variable." In the Examiner's analysis, he apparently interchanges the equivalent of 10^{-5} torr from 0.0013 Pa to 0.013 Pa. The Examiner will appreciate that 0.0013 Pa is roughly the equivalent of 10^{-5} torr, not 0.013 Pa. Furthermore, the Examiner's analysis of claim 32 completely skips over

the fact that claim 32 recites a condensed layer of As_2.

To deposit a condensed layer of As_2, one of the steps involved, as recited in claim 32, is to *"subject the substrate to an As_2 vapor pressure of about 0.008 pa"*. The Examiner is of the opinion that such a feature is obvious because the combination of aforementioned references teaches a vapor pressure of 10^{-5} torr which corresponds to a pressure of 0.0013 Pa, and pressure is a result effective variable. It is the Applicants belief that vapor pressures are only discussed in Hayakawa at Col. 4, lines 48-50 where a vapor pressure in a range of 10^{-6} torr - 10^{-5} torr is discussed. The Examiner has not indicated where any of the other references discuss vapor pressures. This vapor pressure range is roughly equivalent to a range of 0.00013 pa - 0.0013 pa. The Examiner will appreciate though, that a pressure of 0.008 pa claimed in claim 32, is roughly 500% - 5000% greater than the vapor pressure range taught by Hayakawa.

Moreover, where do these references teach depositing a condensed layer of As_2? The Applicants submit that the Examiner has not clearly pointed out where the combination of Hayakawa, Ogasawara, Pessa et al., and Grunthaner et al. teach or suggest, alone or in combination, depositing a condensed layer of any type of atomic species. Furthermore, because these references apparently do not teach depositing a condensed layer of As_2, it would not be obvious to use a vapor pressure of 0.008pa as discussed above and claimed in claim 32.

It is therefore submitted that claim 32 is patentable. Since claim 33 is directly dependent on claim 32, claim 33 is patentable for at least the same reason. If the Examiner maintains his rejection, he is respectfully requested to specifically point out the parts relied upon in Hayakawa, Ogasawara, Pessa et al., and Grunthaner et al. in accordance with 37 CFR 1.104(c)(2).

Patentability of the New Claims

New claims 39 and 40 are patentable because the prior art does not disclose a first crystal (claim 1) or substrate (claim 27) which comprises the first material of the first layer, and a second crystal (claim 1), or crystal (claim 27) which comprises the second material of the second layer, wherein the first material is a group-V species, and the second material is a group-III species.

The Commissioner is authorized to charge any additional fees which may be required or credit overpayment to deposit account no. 12-0415. In particular, if this response is not timely filed, the Commissioner is authorized to treat this response as including a petition to extend the time period pursuant to 37 CFR 1.136(a) requesting an extension of time of the number of months necessary to make this response timely filed and the petition fee due in connection therewith may be charged to deposit account no. 12-0415.

Reconsideration is respectfully requested.

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C., 20231 on:

October 25, 2002
(Date of Deposit)

Richard P. Berg
(Name of Applicant, Assignee or Registered Representative)

(Signature)

10/25/2002
(Date)

Respectfully submitted,

Richard P. Berg
Attorney for Applicant
Reg. No.: 28,145
LADAS & PARRY
5670 Wilshire Boulevard
Suite 2100
Los Angeles, California 90036
323-934-2300

27. (Amended) A method of preparing a substrate for subsequent epitaxial growth of a crystal over the substrate, the method comprising the steps of:

a) cleansing a surface of the substrate by thermal desorption;

b) depositing a first layer of a first material over the surface of the substrate; and

c) depositing a second layer of a second material over the first layer<u>, wherein the crystal is deposited over the second layer</u>.

Please amend the paragraph bridging pages 1 and 2 of the specification to read as follows.

An obstacle in realizing next-generation microelectronic and optoelectronic devices and optimal integration of these devices is found in lattice mismatches between different crystals of group III-V semiconductor materials. Generally, the lattice mismatch between a substrate and an epitaxial over-layer induces strains within the over-layer. This may lead to strain relaxation which can result in formation of material defects such as dislocations within the crystalline structure of the over-layer. Fig. 1 illustrates a mismatched over-layer 1 epitaxially grown over a substrate 2, the boundary between the over-layer 1 and the substrate 2 being indicated with reference numeral 4. As shown in Fig. 1, the lattice constant associated with the over-layer 1 is different from the lattice constant associated with the substrate 2, hence the term "mismatched over-layer". Strain relaxation due to lattice mismatch is accommodated by the formation of mismatch dislocations 3 within the crystal. Defects within a crystal generally degrade the performance of devices made from the crystal, because such defects can scatter movement of carriers (electrons and holes) and can act as carrier traps and/or recombination centers. It is thus useful to provide means for growing a crystal over-layer which has different lattice constant from the substrate on which the over-layer is grown, in such a fashion that strain relaxation does not occur and mismatch dislocations do not form. Fig. 2 is an example of <u>a schematic representation of how lattice mismatch is taken by a condensed layer of group-V species</u> [this], in which the structure of over-layer 1 is preserved and no mismatch dislocations are formed.